



A risk-based approach to cognitive bias in forensic science

Andrew Camilleri*, Damien Abaro, Carolyne Bird, Anne Coxon, Natasha Mitchell, Kahlee Redman, Nicol Sly, Stephen Wills, Edmund Silenieks, Ellie Simpson, Heather Lindsay

Forensic Science SA, GPO Box 2790, Adelaide, SA 5001, Australia

ARTICLE INFO

Keywords:

Cognitive bias
Contextual bias
Minimising cognitive bias
Risk management

ABSTRACT

Over the past decade, the potential impact of cognitive bias in forensic science has instigated much discussion and debate between academics, scientists and those in the justice sector. Evidence of bias influencing subjective decision-making across a range of forensic disciplines has been described in the literature. Forensic service organisations are being urged to address cognitive bias in subjective decision-making by designing processes or procedures to limit access to (irrelevant) contextual information or reduce dependence on cognitive functions. Although some laboratories have implemented bias mitigating strategies, with varying impact on operational efficiency, there has been no systematic assessment of the risk posed by cognitive bias. Forensic Science SA assessed the potential impact of bias on forensic interpretations across multiple disciplines, using a risk management framework. This process proved useful in assessing the effectiveness of existing bias mitigating strategies and identified the latent level of risk posed. While all forensic organisations should seek to implement bias limiting measures that are simple, cost-effective and do not adversely impact efficiency, using a risk-based approach has contextualised the limited benefit of introducing resource hungry measures, as postulated in the literature. That is not to suggest that forensic organisations should dismiss the potential influence of cognitive bias but they need to strike an appropriate balance between risk and return, as they do with any business risk.

1. Introduction

Compared to other witnesses in legal proceedings, expert witnesses occupy a privileged position insofar as they are able to present opinion evidence to the court. Courts may blindly accept a forensic scientist's expert testimony as trustworthy and accurate [1], no doubt in-part, due to the difficulties non-scientists have in fully comprehending highly technical evidence, exacerbated by the often referred "CSI effect". It is therefore crucial that evidence presented by a forensic scientist is valid, accurate and as free as reasonably possible from bias.

Cognitive bias is a widely accepted phenomenon amongst the broader scientific community but, pre-2009, relatively few publications described cognitive bias in forensic science e.g. [2–10]. Forensic scientists largely chose to ignore this literature, some believing, as impartial witnesses, they were not susceptible to cognitive bias influencing their subjective decision-making [11–14]. It took the mounting evidence of wrongful convictions and high-profile blunders in forensic science in the US [15,16], and the 2009 National Academy of Science (NAS) report [17], to spark a flurry of research demonstrating forensic scientists were not immune to influencing bias across a range of disciplines [18–28]. With this mounting evidence, authors and forensic

science bodies globally, began recommending approaches to mitigate the impact of cognitive bias in forensic science [14,18,19,29–39].

If the legal fraternity were not already aware of the NAS report and evidence in the literature, legal academic Gary Edmond and colleagues' 2014 Australia Bar Review paper, *How to cross-examine forensic scientists: A guide for lawyers* [40] focussed their attention on the importance of questioning forensic scientists about the influence of cognitive bias and contextual effects on their interpretations. Edmond et al. [41] then delved further into this topic with the stated aim of educating and stimulating awareness of the effect of human cognition and bias in forensic science. More recently, the 2016 US President's Council of Advisors on Science and Technology (PCAST) report encouraged courts to "assess the measures taken to mitigate bias during casework" [42], pg 101. If forensic scientists choose to ignore the potential influence of cognitive bias on subjective decision-making, they risk having their evidence deemed inadmissible in court or, of greater concern, adversely affecting a justice outcome.

Many of the bias mitigation strategies proposed in the literature reduce or eliminate exposure of forensic scientists to potentially biasing information or practices, however, as has been found during some recently published trials [43,44], in practice these approaches can be

* Corresponding author.

E-mail address: Andrew.Camilleri@sa.gov.au (A. Camilleri).

resource intensive. Forensic science organisations have many competing stakeholder expectations, including high quality scientific analysis and interpretation to meet the standard of proof, timely reporting, cost-effective operations and accountable and transparent practices. Tension forms when existing resources make it difficult to adequately accommodate all of these priorities, creating risks for forensic science organisations. It is therefore imperative that organisations utilise a risk management system to understand their appetite for risks, such as those posed by cognitive bias [45].

Risk management involves a systematic process of risk identification, control and treatment. A clearly defined risk can have its consequence and likelihood assessed, in light of existing mitigation strategies. This process establishes the latent level of risk and, if this exceeds organisational risk appetite, treatments are proposed to mitigate the risk to a tolerable level. Organisations then contemplate the investment necessary to treat the risk, in light of stakeholder expectations. This process of assessing the risk-return relationship determines whether organisations proceed with risk treatment or choose to accept the risk.

We describe below a risk-based approach to the potential influence of cognitive bias on subjective decision-making at Forensic Science SA (FSSA). The purpose of this paper is not to provide an exhaustive list of risks identified across FSSA, although by discussing some of the more globally-recognisable risks, we demonstrate our endeavours to address the potential impact of cognitive bias on our expert interpretations. The utility of applying a risk management framework to practically address potential risk posed by cognitive bias in forensic science is presented and we hope that it provides the basis for other forensic organisations to contextualise risk-return relationship of cognitive bias mitigation strategies.

1.1. Relevant background information about Forensic Science SA

The following narrative describes relevant historical and operational influences for our discussion about cognitive bias at FSSA. While brief, we hope it provides the reader with insight into the environment in which FSSA operates, to better contextualise the approaches we have taken, when applying the risk management framework.

Prior to 1982, forensic science in South Australia was controlled by South Australia Police (SAPOL). *The 1984 Royal Commission Report concerning the conviction of Edward Charles Splatt* [46] included criticisms of bias created by the influence SAPOL had over forensic science at the time “The methods which were followed in this case arising from the relationship between Sergeant Cocks and the forensic scientists highlighted all the danger signs for “unconscious bias” ” [46, pg 51].

To mitigate the impact of the unconscious bias described in Splatt, the report recommended minimum requirements of a forensic science laboratory, stating “there should be a clear and unbroken demarcation between the investigating police and the scientists” [46, pg 51]. Through the subsequent formation of what is now FSSA, forensic science investigations in South Australia were largely extricated from police control, reducing the potential exposure to influencing bias.

Today, FSSA is a multi-discipline, independent forensic science laboratory, residing within the Attorney-General's Department (AGD). FSSA offers services from four scientific and medico-legal groups – Biology, Chemistry, Pathology and Toxicology – providing expertise across evidence recovery, bloodstain pattern analysis (BPA), textile damage analysis (TDA), DNA, document examination, trace evidence, illicit drugs (and clandestine drug laboratories), toxicology, anthropology and pathology. To maintain the viability of each of these disciplines within existing resources, some staff provide expertise across multiple disciplines. The provision of other forensic services, in South Australia are delivered by SAPOL or other agencies.

With the exception of clandestine drug laboratory, pathology and anthropology services, FSSA staff do not attend crime scenes to collect evidence, as the remit of this lies with SAPOL. The investigating officer

or SAPOL Crime Scene Investigator creates a manifest of samples or exhibits for forensic examination and provides this list to FSSA, either electronically or in-person. FSSA triage staff review the manifest and, using contextual case information and agreed policies, triage the exhibits to ensure FSSA's scientific resources target samples and exhibits with the greatest likelihood of generating a result and/or probity to the investigation. While exhibit triage staff primarily focus on triaging exhibits requiring DNA analysis, senior reporting scientists, from other disciplines are often separately required to advise on the suitability of collected exhibits for scientific analysis. In the most serious matters (eg homicides or cases with a high public profile), reporting scientists, but not necessarily triage staff, and major crime detectives meet to discuss and agree exhibits for testing. A laboratory information management system (LIMS) is used to record all pre-submission correspondence, including triage decisions.

Accompanying samples and exhibits at submission, is a request for examination form, completed by the investigating officer. This form details; *offence category, location and date, name, date of birth, sex and racial origin of the suspect/victim, date results requested by and reasons for urgency, associated reports*, a free text field titled *case summary and additional information* and includes a free text field titled *reason for submitting items for examination*.

Depending on the stage of the case at FSSA, pre-submission correspondence, examination request forms and notations, analytical findings and interpretations from analyses conducted are accessible to analysts working on the matter in the LIMS and/or the casefile (some exceptions apply). Once the file is allocated to a reporting scientist(s), enquiries and correspondence between FSSA and the investigator are generally handled by that reporting scientist.

FSSA's charter is to provide independent, high quality, expert scientific evidence, opinion and information to the justice system and community of South Australia. The principle of our charter is to ensure, beyond reasonable doubt, the accuracy of our results and interpretations. It is therefore implicit that we take the steps necessary in our operations to achieve the standard of proof. Generally, Government, independent of client demand for our services, appropriates our funding. This allows us to take a pragmatic approach in deciding how to allocate our resources in delivering our charter, whilst also attempting to satisfy client expectations of efficient and timely services. There remains the possibility that our clients could engage services of other Australian forensic laboratories, or the very small number of boutique private forensic service providers, if their service-delivery expectations are not met however, we feel confident that if we deliver our charter, our clients will continue to highly value our services.

2. Materials and methods

2.1. Cognitive bias working party

FSSA staff were canvassed to participate in a working party to examine the influence of cognitive bias on subjective decision-making at FSSA. Staff self-nominated but included senior experts from all forensic disciplines across FSSA, including a representative from the exhibit triage team.

The extent of their exposure to the cognitive bias literature varied, however several participants had experience implementing bias mitigating strategies within their discipline. Prior to commencing their assessment, the working party attended a series of cognitive bias presentations and a workshop to familiarise themselves with relevant literature, including recommendations and guidelines relating to mitigating the impact of cognitive bias in forensic science.

The working party convened to identify and discuss FSSA-wide cognitive bias risks, whilst considering discipline-specific cognitive bias risks individually, or in small groups, between workshops.

2.2. Risk assessment

The methodology applied by the working party utilised the AGD Audit and Risk Management Committee approved Risk Management Procedure [47], adapted from the ISO standard for Risk Management [48]. This procedure provided guidance in developing, managing and treating risks, as well as developing and maintaining a risk register.

The working party reviewed all of FSSA's operational activities and identified processes where cognitive bias could influence interpretations. A description of each risk cause was captured in the AGD Risk Assessment template (Appendix I). The working party then determined the consequence and likelihood of the risk occurring, using the definitions provided on the AGD Risk Matrix (Appendix II), both before and after the application of existing controls. The effectiveness of the existing controls determined the residual risk.

2.3. Risk treatment

Treatments were proposed for any risk with a residual risk of *High* and any FSSA-wide risk with a residual risk of *Moderate*, to attempt to reduce the likelihood of that risk occurring, noting that the consequence was unlikely to be impacted. Formulation of risk mitigation strategies was influenced by the operational experience of the working party and awareness of mitigation strategies proposed in the literature. The effectiveness of each treatment was classified as *Low*, *Medium* or *High* and included reasoning for each classification to allow appropriate consideration of the treatment against the impact of implementation. Each treatment was also designated an owner and a timeline for implementation.

2.4. Recommendations

The working party used the proposed treatments to formulate a series of recommendations for implementation at FSSA. The recommendations were presented to FSSA's Management Group, seeking endorsement for implementation. The Management Group considered the recommendations and endorsed the majority of them, after suggesting some minor amendments. The recommendations were then allocated to their respective owners, to commence implementation.

3. Results

The working party identified 32 risks associated with cognitive bias across FSSA. Risks 1–10 (described in Appendix III) applied across multiple disciplines, with further discussion about these “FSSA-wide” risks detailed below. The remaining 22 risks were relevant to individual disciplines. For brevity these 22 risks are not articulated further in this paper but are being considered for publication separately. Numbers in round brackets in the rest of this section refer to the risk number in Appendix III.

3.1. FSSA-wide risks

Despite FSSA's independence from police, some investigative information is freely accessible to scientists and analysts. This information can be task-relevant or task-irrelevant, depending on the individual case and the forensic discipline conducting the examination. Information detailed by clients on FSSA's request for examination form is the most likely source of this information although, exchanges between FSSA staff and investigators during case management meetings, exhibit triage, case communications or reporting intelligence, creates opportunities for exposure to potentially biasing task-irrelevant information. Risks 1–5 capture circumstances where staff may be exposed to task-irrelevant information. These instances have the potential to influence decisions made during exhibit triage (1), exhibit selection (2), when sampling an exhibit (3), when performing analytical

interpretations (4) and when determining a need for exhibit reanalysis (5). The working party acknowledged that there are complexities in determining what is task-relevant and task-irrelevant in all cases, but particularly in Pathology cases where circumstantial information surrounding the death of an individual is an essential and integral part of the diagnostic and interpretative process. The working party accepted that Pathology would consider this as part of their discipline-specific risks. This highlights the need to focus on individual disciplines and tasks when considering the potential for cognitive bias, as what may be considered irrelevant (and potentially biasing) for one discipline or task, may be relevant (and potentially biasing, or not) for a different discipline or task.

Multi-disciplinary cases present additional challenges at FSSA. A risk of unconscious bias influencing interpretations occurs when the same analyst conducts examinations in two separate scientific disciplines or when information is exchanged between staff working on the same matter in different disciplines. A result in one discipline has the potential to unconsciously bias an analyst's interpretation in another discipline. Even when the specific result of the analytical finding/interpretation is unknown, the mere association may be biasing. By way of an example, when a DNA analyst identifies DNA on a balaclava found at the scene of a break and enter where a window was broken to gain access and that analyst informs a trace evidence expert that the balaclava requires searching for glass fragments, the trace expert may make the inference that the suspect's DNA has been identified on the balaclava. Risk 6 captures scenarios such as these, where the potential exposure to task-irrelevant information from completed analyses in another discipline or from intelligence work at FSSA could bias subsequent decision-making.

Risks 7 and 8 describe base-rate regularities and/or task irrelevant information causing an expectation that samples are the same (7), or that a particular result from an exhibit/sample is likely (8). Examples of these risks include the use of a presumptive test result to guide the analytical strategy applied (7), a specific request for a test to be applied to a particular sample/exhibit (8) or, because the sample/exhibit source is from the police and its significance to that matter has been assessed through triaging, it is expected to match the known (7) or produce an evidentiary result (8). This is likely to have the greatest influence when it is expected that two samples are the same (e.g. a crime scene sample and a control/standard).

A base-rate regularity is also caused when an analyst unconsciously discounts inclusions or exclusions from computer generated database/library search matches. This bias is caused when the most successful match is presented to the analyst at the top of the list, together with the degree of success of that match. This scenario is described by risk 9 in the risk assessment.

Reports issued by FSSA are administratively and technically reviewed prior to release to clients (some exceptions apply). Aside from having the interpretations of the reporting scientist accessible in the text of the report, the reviewer also has access to information detailed in the LIMS, notations made during the examination and annotated analytical results in the case file. Risk 10 describes the confirmation bias caused by exposure to this information during the technical review of a report. The risk description also captures the potential for reviewers to be unconsciously biased towards interpretations of reporting scientists due to their position or prominence. The working party again agreed that this risk needed to be considered separately in Pathology (who practice a multi-stage peer review process) [49] because of the need to review anatomical findings described in the report.

The working party assessed each of the risks associated with cognitive bias, to determine the potential overall impact of the bias. In doing so, the working party agreed that the risks described fell into two distinct categories. The first category was where the bias might influence selection decisions but, any interpretations of the subsequent analytical results obtained from the selected item would not be influenced. The reported result would therefore be accurate, perhaps just not

as probative as a result generated from an unbiased decision. These risks were described in the risk description as ...*favouring one party over another*. The second category of risk was where the bias could directly impact or cascade bias [21,50] to the result/interpretation used as evidence in court or may influence other aspects of evidence in the matter e.g. the results of scientific examinations could subsequently influence a witness statement. The biased result/interpretation therefore could cause a miscarriage of justice and, relevant to the risk matrix (Appendix II), potentially a lengthy term of imprisonment. While seen as an improbable set of circumstances that matters potentially resulting in a lengthy term of imprisonment would rely solely on one critical forensic result/interpretation, precedence exists [for example see 15,46,51]. These risks were described in the risk description as ...*contributes to a miscarriage of justice*.

3.2. Risk assessment

Using the guiding notes describing consequence scenarios in the risk matrix (Appendix II), the working party agreed that a potential exposure category of *Major* was appropriate for risks (4, 6–10) where the risk ...*contributes to a miscarriage of justice*. Where the risk (1–3, 5) resulted in ...*favouring one party over another*, the potential exposure was considered to be *Minor*.

It is clear that the likelihood of risks categorised as ...*favouring one party over another* could occur in most instances and therefore these risks were allocated a likelihood of *Likely (to occur in most circumstances)*. We do not know with any certainty the frequency of instances where cognitive bias has influenced the processes described by the risks categorised as ...*contributes to a miscarriage of justice* at FSSA. We are left to make an estimate based upon consideration of the circumstances necessary for this outcome to occur, which, as mentioned previously, we view as an improbable set of circumstances albeit, not without precedence. We therefore arrived at a likelihood of *Possible (to occur in most circumstances)*, which we feel is neither too conservative nor too prevalent.

With the exception of risk 10, risks allocated with a potential exposure of *Major* had existing controls mitigating the risk that were either *Substantially Effective* (4, 7–9) or *Partially Effective* (6). These controls resulted in the likelihood of the risk occurring being *Unlikely* (4, 6, 7) or *Rare* (8, 9), which, using the risk matrix, created an overall *Moderate* level of risk for FSSA. While this level of risk is generally tolerable, the risk treatment option proposed by the working party for risks 4, 6 and 7 was *Change the likelihood*, as the working party felt that treatments could further reduce the likelihood of occurrence. FSSA decided to *accept the risk* posed by risks 8 and 9.

Risk 10 was the final FSSA-wide risk deemed to have a *Major* potential exposure for FSSA. It was apparent to the working party that, excluding measures in questioned documents, there were no controls in place to mitigate against this risk. The likelihood of this risk occurring was therefore categorised as *Possible*, resulting in an overall *High* level of risk. Risk 10 therefore required treatments to be proposed to mitigate against the likelihood of it occurring.

The risk of exposure to task irrelevant information from investigators or other FSSA staff, unconsciously biasing exhibit; triage (1), selection (2), sampling (3) or reanalysis (5) was designated as having *Minor* consequences to FSSA. The decisions described in risks 1–3 occur numerous times daily however, the likelihood of these risks occurring are offset by some *Partially Effective* existing controls. The working party determined that, despite the existing controls, their likelihood of occurrence was still *Likely*. Using the risk matrix, the overall level of risk for these four risks was *Moderate*. Again, this is level of risk is usually tolerable but, the working party felt that the likelihood could be reduced by considering relevant treatments.

Of the 22 discipline-specific risks not detailed in this paper, only two were considered by the working party to have a latent level of risk as *High*, with the remaining risks within the risk tolerance of FSSA.

Treatments were proposed to reduce the likelihood of the two discipline-specific risks rated *High*.

3.3. Risk treatment

The objective of risk treatment is not to eliminate every risk identified in the risk assessment. The process of identifying potential treatments is to establish the effectiveness of the treatment against the risk-return relationship, when resourcing and competing shareholder priorities are considered.

The treatments proposed by the working party for the eight FSSA-wide risks posing a *High* or *Moderate* risk to FSSA are detailed in Appendix IV. Many of the treatments proposed are formulated from bias mitigating recommendations within the literature or from international forensic science bodies [14,18,19,29–39]. Between four and 14 potential treatment options were proposed by the working party for each of these eight risks. Through this process, it quickly became apparent that many of the 22 discipline-specific risks would also be mitigated by the treatments proposed for the FSSA-wide risks. The discipline-specific risks did however, have isolated treatments proposed, which are not described further here.

It was rapidly acknowledged by the working party that some treatments were impractical, mainly due to the significant resources required for implementation. It was obvious to the working party that these treatments would create new separate risks for FSSA and therefore, where a treatment had an obvious significant detrimental impact on resources or created a new risk, the treatment was not recommended by the working party for implementation. Examples of the mitigation strategies not recommended by the working party included having *two independent analysts report a case and later compare findings* (significant detrimental impact on resourcing) and *limit opportunities for investigators to include task-irrelevant information* (creates a new risk). In instances where the efficiency of a treatment was recognised as having a detrimental impact on resources but, it was highly effective at treating the risk, the treatment was still recommended by the working party, with a caveat acknowledging the potential consequence of implementation. The working party felt it was outside the project scope to make a decision on allocation of resources to the proposed treatments, which was the purview of FSSA's Management Group.

Further restricting the effectiveness of some of the proposed treatments was the small pool of appropriately qualified staff in some disciplines. The number of experts capable of reporting BPA/TDA, document examination, trace evidence and advanced DNA interpretations at FSSA is insufficient for implementation of some of the recommendations. For example, given the number of experts available, it would be virtually impossible for an expert from one of these disciplines who was involved in triaging a case, to not have any further involvement with that case. Similarly, in document examination and trace evidence cases which may have more than one evidence type requested in a matter, it is unlikely that more than one expert can be assigned to make interpretations of each evidence type (e.g. handwriting and signatures, or paint and fibres, respectively), for reasons of resources, continuity and efficiency.

3.4. Recommendations

From the proposed treatments, the working party produced 13 recommendations for consideration by FSSA's Management Group. The recommendations were allocated across three broad categories of; *Raising awareness of cognitive bias*, *Limiting access to task irrelevant information* and *Reducing expectation bias*.

3.4.1. Raising awareness of cognitive bias

1. Introduce annual cognitive bias awareness sessions highlighting:
 - During discussions about cases between staff, exchange of task-

irrelevant information should be limited, given that task-relevant information in one discipline or examination may be task-irrelevant in others,

- reports generated in other disciplines are not be accessed, unless it is task-relevant or required for operational purposes.
2. Introduce new staff to cognitive bias at induction and annually assess understanding of cognitive bias amongst existing staff.
 3. Generate a guidance document on how to mitigate cognitive bias in FSSA's operational processes.

3.4.2. Limiting access to task irrelevant information

4. Where possible, the discipline expert attending a case management meeting does not have any further involvement with the examination, analysis, reporting or review of the case and minutes from case management meetings are not accessible to discipline experts.
5. Where resourcing allows, staff performing triaging do not have any further involvement with the examination, analysis, reporting or review of a case they have triaged.
6. Staff performing exhibit triage redact task-irrelevant information on the request for examination form submitted by the client.
7. FSSA reviews the effectiveness of implementation of recommendations 5 and 6 after a trial of no more than twelve months and then considers implementing a case manager.

3.4.3. Reducing expectation bias

8. Where possible, and where it does not negatively affect efficiency, the discipline expert does not perform analyses or reviews across multiple disciplines in the same matter.
9. Enhance FSSA's LIMS to prevent access to task irrelevant results/reports generated in other disciplines.
10. Where possible, and where it does not negatively affect efficiency, the interpretation of the evidence from the crime scene is completed and documented prior to being exposed to and working with the reference material.
11. FSSA considers options to introduce blind known tests to counter expectation bias.
12. FSSA Management Group consider options to limit access to annotations relating to opinions made by the analyst, when the case file review is conducted.
13. A trial to assess the impact of reviewing case files without initial access to the report and interpretations of the reporting scientist is undertaken.

3.5. Management group support

Ten of the 13 recommendations were supported by the Management Group. Recommendations 9 and 12 were not supported because the Management Group felt these would be adequately addressed through the strategies targeting increasing awareness of cognitive bias amongst staff.

Recommendation 13 was not supported because it was deemed too inefficient to implement. One recent study has shown the value of blind verification in BPA [43], despite it being resource intensive, while another has shown that blind verification procedures significantly increase the duration of the verification process through additional time for both the verification procedure and to blind relevant material before the verification [44]. FSSA deemed that the resources required to implement this strategy were not in keeping with elements of our charter

relating to cost-effective operations and timely reporting.

4. Discussion

The impact of cognitive bias on decision-making processes at FSSA has been assessed using a risk management approach. This revealed 32 cognitive bias risks, of which 29 carried a level of risk within the risk appetite of FSSA, meaning these risks did not to require treatment to further mitigate the risk. Despite this, processes involving more than one discipline with a *Moderate* risk, and the three processes with a *High* risk, had treatments recommended to reduce the likelihood of the risk occurring. The majority of the recommendations were endorsed by FSSA's Management Group and could be implemented within a risk-return relationship that considered existing resources and our charter to produce valid, accurate and unbiased interpretations to the justice system of South Australia and meet the standard of proof. FSSA is now working through the implementation of the endorsed recommendations.

The risk management framework presented above demonstrates the utility of using such a process to contextualise the practical impact of potential sources of cognitive bias on decision-making. We acknowledge that this risk process may not be directly applicable or translatable to other forensic science organisations because FSSA;

- Operates independently of police control,
- Is a multi-disciplinary forensic science laboratory,
- Operates within an adversarial justice system in Australia, and
- May have a different risk appetite to other organisations.

There is one obvious limitation inherent in conducting an internal risk assessment, which, coincidentally, introduces bias to the methodology. By utilising the services of forensic experts to conduct the risk assessment, their intimate business process knowledge is crucial however, their own pre-existing biases may mean that their assessments of potential bias, its potential impact and the success of existing bias mitigating strategies, is likely to be less subjective than an independent external assessment. By publishing our assessment, we encourage critiquing and commentary, in the hope that it will not only improve our assessment but aid those laboratories interested in adopting a similar approach.

Regardless of the limitations and applicability issues detailed above, we urge other forensic science organisations to adapt this framework and refine the FSSA-wide risks presented here, for their environment. We view this as the commencement of a more balanced and active response from forensic science organisations to the potential impact of cognitive bias in forensic science. It allows organisations to prioritise their response to cognitive bias against the risk-return relationship of shareholder expectations and resources, and in light of other risks facing their organisation.

Declarations of interest

None.

Novelty statement

This is the first time a risk management tool has been utilised to assess the impact of cognitive bias in forensic science and the material presented can be adapted by other laboratories to assess the influence of cognitive bias on subjective decision-making.

Appendix I. Risk assessment template [47]

Risk description	Risk cause	Potential exposure	Existing controls	Control effectiveness	Level of risk				
					Consequences	Likelihood	Level of risk	Risk treatment option	Owner
A structured statement containing four elements: sources, events, causes and consequences	What will cause the risk to occur?	The maximum plausible impact arising from a risk without regard to controls (insignificant, minor, moderate, major or severe)	A measure that is currently modifying risk	A measure of the adequacy and effectiveness of existing controls; Totally ineffective - virtually no credible control, Largely ineffective - significant control gaps because either controls do not treat root causes or they do not operate at all effectively, Partially effective - while the design of controls may be largely correct in that they treat most of the root causes of the risk, they are not currently very effective or some of the controls do not seem correctly designed in that they do not treat root causes, those that are correctly designed are operating effectively, Substantially effective - most controls are designed correctly and are in place and effective, Fully effective - nothing more to be done except review and monitor the existing controls. Controls are well-designed for the risk, address the root causes and they are effective and reliable at all times.	The outcome of the risk event after taking into account the effectiveness of existing controls (insignificant, minor, moderate, major or severe)	The likelihood of something happening and leading to the assessed level of consequence (rare, unlikely, possible, likely or almost certain)	The magnitude of risk remaining after taking into account the effectiveness of existing controls. Level of risk is a factor of the consequence and likelihood (low, moderate, high or extreme)	The option to modify the risk; Do something different - e.g. decide not to start or continue with the activity that gives rise to the risk, Change the likelihood - reduce or increase the risk by changing the likelihood, Change the consequence - reduce or increase the risk by changing the consequence, Share the risk - share the risk with another party or parties (including contracts and insurance), Accept the risk - retain the risk by informed decision	Discipline the risk applies to

Appendix II. Risk matrix [adapted from [47]]

Consequence	Likelihood				
	Rare May occur but only in rare and exceptional circumstances	Unlikely Unlikely to occur in most circumstances	Possible Possible to occur in most circumstances	Likely Is likely to occur in most circumstances	Almost Certain Almost certain to occur in most circumstances
Severe Social/People - Fatality or irreversible severe disability or impairment: long term workforce or community harm Service Delivery – State-wide cessation of multiple services or programs Reputation & Image – Agency reputation irreparably damaged; Ministerial resignation	Moderate	High	High	Extreme	Extreme
Major Social/People – Extensive injuries, permanent partial disability or time lost from work of one day/shift or more Service Delivery – State-wide cessation of a number of services or programs	Moderate	Moderate	High	High	Extreme

Reputation & Image – Sustained adverse publicity; Chief Executive resignation/removal										
Moderate		Low		Moderate	Moderate	High	High			
Social/People – Significant non-permanent injury with limited period of disability, where medical treatment is required										
Service Delivery – State-wide disruption to a number of services or programs										
Reputation & Image – Significant adverse publicity										
Minor		Low		Low	Low	Moderate	Moderate			
Social/People - Insignificant non-permanent injury/illness, where treatment administered by first aider										
Service Delivery – Some disruption to services or programs										
Reputation & Image – Localised adverse publicity										
Insignificant		Low		Low	Low	Low	Low			
Social/People – Report only – no injury/illness										
Service Delivery – No disruption to services or programs										
Reputation & Image – Minimal adverse local publicity										

Appendix III. Risk assessment

Risk #	Risk description	Risk cause	Potential exposure	Existing controls	Control effectiveness	Level of risk			Risk treatment option	Risk owner (discipline)
						Consequences	Likelihood	Level of risk		
Exposure to task irrelevant information at case management meetings, through correspondence with investigators, on the request for examination form or through discussions with other FSSA staff, ... favouring one party over another										
1	...prior to performing exhibit triage influences triage decisions, ...	Staff are exposed to task irrelevant information by investigators or other FSSA staff	Minor	<ul style="list-style-type: none"> Acceptance criteria for DNA exhibits is generally based on policies informed by success rates Acceptance criteria for DNA and trace evidence exhibits is generally based on the exhibits that provide the most probative information 	Partially effective	Minor	Likely	Moderate	Change the likelihood	Triage & Trace
2	...influences the selection of an exhibit, including requesting submission of items not previously submitted, for analysis, ...			<ul style="list-style-type: none"> Selection criteria for DNA exhibits is generally informed by success rates Selection criteria for DNA and trace evidence exhibits is generally based on the exhibits that provide the most probative information 						Biology & Trace
3	...influences the sampling strategy on an exhibit, ...			<ul style="list-style-type: none"> Triage staff not involved in searching exhibits (DNA only) Photographs of some exhibits searched and notes detailing the searching performed are retained in case file for independent review 						Evidence Recovery, BPA/TDA, Biology & Trace
4	...influences interpretations, resulting in a different result being reported, which contributes to a miscarriage of justice.		Major	<ul style="list-style-type: none"> Sequential unmasking in place in Document Examination, BPA & TDA analysts attempt to minimise the information they access prior to conducting an examination Identification of unknown is governed through mass spectral acceptance 	Substantially effective	Major	Unlikely	Moderate		BPA/TDA, Biology, Trace, Document Examination, Toxicology, Illicit Drugs & Anthropology

				<ul style="list-style-type: none"> criteria and retention time matched to contemporaneously run standard in Illicit Drugs, Toxicology and Ignitable Liquid Residue Analysis • STRMix automates the matching criteria in DNA • Refractive index of each recovered glass fragment is measured and grouped individually prior to measuring the control • All differences between the recovered material and the reference material, however slight, are noted in the file and an explanation and reasoning included for fibres and paint analyses, respectively • Identification of GSR requires presence of at least two of three characteristic elements • Findings are reviewed by an independent scientist during the scientific review of the file 						
5	...influences the analyst to re-examine/re-analyse an item/sample when it otherwise would not have been resulting in a different result being reported, ...		Minor	<ul style="list-style-type: none"> • None 	N/A	Minor	Likely	Moderate	Change the likelihood	BPA/TDA, Biology & Trace
6	<p>Knowledge of analytical results from other exhibits in the matter</p> <p>Knowledge of the completed analyses from intel exhibits or exhibits analysed in other disciplines influences interpretations, resulting in an incorrect result/interpretation being reported, which contributes to a miscarriage of justice.</p>	Access to/knowledge of the results of other analytical work	Major	<ul style="list-style-type: none"> • Pathology reports are not accessible to other groups at FSSA via the LIMS • Identification of unknown is governed through mass spectral acceptance criteria and retention time matched to contemporaneously run standard in Illicit Drugs, Toxicology and Ignitable Liquid Residue Analysis • STRMix automates the matching criteria in DNA • Refractive index of each recovered glass fragment is measured and grouped individually prior to measuring the control • All differences between the recovered material and the reference material, however slight, are noted in the file and an explanation and reasoning included for fibres and paint 	Partially effective	Major	Unlikely	Moderate	Change the likelihood	BPA/TDA, Biology, Trace, Document Examination, Toxicology, Illicit Drugs & Anthropology

				analyses, respectively						
				<ul style="list-style-type: none"> • Identification of GSR requires presence of at least two of three characteristic elements • Findings are reviewed by an independent scientist during the scientific review of the file 						
Analyst accepts a match or dismisses/explains away minor exclusionary information because it is..., resulting in a different result being reported and a miscarriage of justice										
7	...expected that two samples are likely to match...	Base-rate regularities and/or task irrelevant information	Major	Those listed at Risk 6 and;	Substantially effective	Major	Unlikely	Moderate	Change the likelihood	Biology, Trace, Documents & Illicit Drugs
8	...expected that a particular result will be obtained because of a pre-existing result (eg presumptive test), the source of the samples (eg police submission) or specific request for analysis (eg by Pathologist) ...	Base-rate regularities and/or task irrelevant information	Major	<ul style="list-style-type: none"> • Person reading DNA profile does not have access to biasing information in file when performing interpretations 		Major	Unlikely	Rare	Accept the risk	Biology, Trace, Illicit Drugs & Toxicology
Computer generated database/library search matches										
9	Analyst accepts the top match at the expense of reviewing other matches or dismisses / explains away minor exclusionary information resulting in a different result being reported, which contributes to a miscarriage of justice.	Base-rate regularity caused by automated hit-lists presenting algorithmically generated most likely match at the top of the list and analyst not reviewing other matches	Major	<ul style="list-style-type: none"> • Identification of unknowns is governed through mass spectral acceptance criteria and retention time match to contemporaneously run standard in Illicit Drugs, Toxicology and Ignitable Liquid Residue Analysis. • In Illicit Drugs, mass spectral/retention time similarities known and contingencies in place ie derivatisation and simultaneous running of known inclusion standard • Mass spectral data generated is presented to an independent reporting officer for review prior to reporting • Mass spectral data reviewed by an independent scientist during the scientific review of the file 	Substantially effective	Major	Rare	Moderate	Accept this risk	Illicit Drugs, Toxicology, Paint, Fibres & Ignitable Liquid Residue
Casefile review										
10	Casefile reviewer accepts incorrect interpretations of reporting officer resulting in a different result being reported, which contributes to a miscarriage of justice.	Confirmation bias caused by the status of the reporting officer or the casefile reviewer having access to the report and annotated analytical results in casefile whilst conducting the review	Major	<ul style="list-style-type: none"> • Reviewer considers questioned material before looking at comparison material, and forms their own opinion based on the material before reading the reporting officer's notes or report in Document Examination 	Largely ineffective	Major	Possible	High	Change the likelihood	All excluding pathology

Appendix IV. Risk treatment

Risk	Treatment	Effectiveness (reasoning)
1	Exhibit triage	

	<ul style="list-style-type: none"> ● Allow SAPOL to make more triage decisions 	Low (returns more control over what is/isn't tested to SAPOL, which was a criticism in the Splatt Royal Commission report [46])
	<ul style="list-style-type: none"> ● Change the request for analysis form to limit opportunity for investigators to include task-irrelevant information 	Low (not recommended for implementation - each case circumstance is different and some information that is task-irrelevant to some disciplines is task-relevant in others and therefore eliminating this information may create new risks)
	<ul style="list-style-type: none"> ● Educate SAPOL about the potential influence of cognitive bias from task-irrelevant information on decision making 	Medium (easy and cost-effective to implement but may have a limited duration of effectiveness)
	<ul style="list-style-type: none"> ● Further educate FSSA staff about the potential influence of cognitive bias from task-irrelevant information on decision making 	High (may impact on job satisfaction of staff who are not aware of the circumstances of offending and could be costly to implement because it requires some structural change, training, knowledge of what information is relevant to different groups across FSSA and potentially impacts on existing resources and efficiency)
2–5	Exhibit selection/sampling/interpretation/reanalysis (treatments in 1 plus) <ul style="list-style-type: none"> ● Case Manager allocated who liaises with clients (including attendance at case management meetings and performs all correspondence with clients) and FSSA staff, conceals task irrelevant information on the request for examination form and, if necessary, creates a worklist ● Staff attending the case management meeting do not examine exhibits in the same matter ● Triage scientist does not have further involvement with a case they have triaged and conceals task-irrelevant information on the request for examination form, indicating when it can be revealed (sequential unmasking) ● Triage scientist does not have further involvement with a case they have triaged ● Triage scientist conceals task-irrelevant information on the request for examination form indicating when it can be revealed (sequential unmasking) 	Medium (may not be enough staff in some disciplines to separate this function, requires training, knowledge of what information is task-irrelevant and potentially impacts on existing resources and efficiency)
	<ul style="list-style-type: none"> ● Report contains a statement outlining what information was known before decisions were made 	Medium (may not be enough staff in some disciplines to separate this function, requires training, knowledge of what information is task-irrelevant and potentially impacts on existing resources and efficiency)
6	Knowledge of results from other items in the matter <ul style="list-style-type: none"> ● Different analysts independently complete work of different evidence types ● Further educate staff about the risk of task-irrelevant information on decision making ● LIMS is configured so that it is not possible to view results/reports of work completed in other disciplines 	Medium (may not be enough staff in some disciplines to separate this function, requires training, knowledge of what information is task-irrelevant and potentially impacts on existing resources and efficiency)
7	Expectation that two samples are the same (treatments in 1–5 plus) <ul style="list-style-type: none"> ● Introduce known blind non-matches to counter the base-rate expectation ● Use evidence line-ups so there are multiple samples to compare against ● Analysis and interpretation of the unknown is completed and documented before analysis of the known and comparison of the two ● Compare the spectra within the software packages to determine their correlation (paint and fibre examinations) 	High (may be difficult to conceal the inclusion of these amongst legitimate casework samples) High (not recommended for implementation - difficult to implement, client/case manager would need to have the appropriate samples, impacts efficiency, wait for automation through AI)
10	Casefile review <ul style="list-style-type: none"> ● Two independent analysts report cases and later compare findings ● All casefile notes kept electronically where annotations made can be concealed from reviewer ● Annotations removed from casefile notes ● Casefile review conducted blind without initial access to findings/conclusions/report 	Medium (staff already aware that they should not routinely access casework completed in other disciplines) High (not suitable to all analyses – specific to trace evidence disciplines) Low (low level correlation can be easily explained away i.e. paint smeared is a mixture, higher levels of solvent still present, degradation of samples)
		High (not recommended for implementation - has a crippling impact on existing resources and efficiency) Medium (will require significant resources to configure existing software and will come at a considerable financial cost) Medium (not recommended for implementation – National Association of Testing Authorities, Australia (NATA) independent accreditation relies on notations of reasoning as to why a conclusion has been made to be included in the file) High (adversely impacts on existing resources and efficiency)

References

- J.L. Mnookin, S.A. Cole, I.E. Dror, B.A. Fisher, M. Houck, K. Inman, D.H. Kaye, J.J. Koehler, G. Langenburg, D.M. Risinger, N. Rudin, J. Siegel, D.A. Stoney, The need for a research culture in the forensic sciences, *UCLA L. Rev.* 58 (2011) 725–779.
- W.E. Hagan, *A Treatise on Disputed Handwriting and the Determination of Genuine from Forged Signatures*, Banks & Brothers, New York, 1984.
- L.S. Miller, Bias among forensic document examiners: a need for procedural change, *J. Police Sci. Adm.* 12 (1984) 407–411.
- L.S. Miller, Procedural bias in forensic examination of human hair, *Law Hum. Behav.* 11 (1987) 157–163.
- M.J. Saks, D.M. Risinger, R. Rosenthal, W.C. Thompson, Context effects in forensic science: a review and application of the science of science to crime laboratory practice in the United States, *Sci. Justice* (2) (2003) 77–90.
- B. Budowle, M.C. Bottrell, S.G. Bunch, R. Fram, D. Harrison, S. Meagher, C.T. Oien, P.E. Peterson, D.P. Seiger, M.B. Smith, M.A. Smrz, G.L. Soltis, R.B. Stacey, A perspective on error, bias, and interpretation in the forensic sciences and direction for continuing advancement, *J. Forensic Sci.* 54 (2009) 798–809.
- I.E. Dror, D. Charlton, A.E. Péron, Contextual information renders experts vulnerable to making erroneous identifications, *Forensic Sci. Int.* 156 (2006) 74–78.
- I.E. Dror, D. Charlton, Why experts make errors, *J. Forensic Identif.* 56 (2006) 600–616.
- I.E. Dror, R. Rosenthal, Meta-analytically quantifying the reliability and bias ability of forensic experts, *J. Forensic Sci.* 53 (2008) 900–903.
- I.E. Dror, A. Péron, S. Hind, D. Charlton, When emotions get the better of us: the effect of contextual top-down processing on matching fingerprints, *Appl. Cogn. Psychol.* 19 (2005) 799–809.
- J. Kukucka, S.M. Kassin, P.A. Zapf, I.E. Dror, Cognitive bias and blindness: a global survey of forensic science examiners, *J. Appl. Res. Mem. Cogn.* 6 (2017) 452–459.
- R.D. Stoel, I.E. Dror, L.S. Miller, Bias among forensic document examiners: still a need for procedural changes, *Aust. J. Forensic Sci.* 46 (2014) 91–97.
- B. Found, Deciphering the human condition: the rise of cognitive forensics, *Aust. J. Forensic Sci.* 47 (2015) 386–401.
- S.M. Kassin, I.E. Dror, J. Kukucka, The forensic confirmation bias: problems, perspectives, and proposed solutions, *J. Appl. Res. Mem. Cogn.* 2 (2013) 42–52.
- The Innocence Project, USA, <https://www.innocenceproject.org>, (2018), Accessed date: 12 November 2018.
- Office of the Inspector General, A Review of the FBI's Handling of the Brandon Mayfield Case, US Department of Justice, Washington DC, 2006.
- National Research Council, *Strengthening Forensic Science in the United States: A Path Forward*, The National Academies Press, Washington, DC, 2009.
- J. Kukucka, S.M. Kassin, Do confessions taint juror perceptions of handwriting evidence? an empirical test of the forensic confirmation bias, *Law Hum. Behav.* 38 (2013) 256–270.
- P. Bieber, Measuring the impact of cognitive bias in fire investigation, International Symposium on Fire Investigation Science and Technology, 2012 Maryland, USA.
- R. Zajac, N. Osborne, J.A. Kieser, *Contextual Bias in the analysis of Bitemarks*, Wiley Encyclopaedia of Forensic Science, John Wiley & Sons Ltd, 2009.
- S. Nakhaeizadeh, R.M. Morgan, C. Rando, I.E. Dror, Cascading Bias of initial exposure to information at the crime scene to the subsequent evaluation of skeletal remains, *J. Forensic Sci.* 63 (2017) 403–411.
- S. Nakhaeizadeh, I.E. Dror, R.M. Morgan, Cognitive bias in forensic anthropology: visual assessment of skeletal remains is susceptible to confirmation bias, *Sci. Justice* 54 (2014) 208–214.

- [23] P.A.F. Fraser-Mackenzie, I.E. Dror, K. Wertheim, Cognitive and contextual influences in determination of latent fingerprint suitability for identification judgments, *Sci. Justice* 53 (2013) 144–153.
- [24] I.E. Dror, C. Champod, G. Langenburg, D. Charlton, H. Hunt, R. Rosenthal, Cognitive issues in fingerprint analysis: inter and intra-expert consistency and the effect of a 'target' comparison, *Forensic Sci. Int.* 208 (2011) 10–17.
- [25] I.E. Dror, G. Hampikian, Subjectivity and bias in forensic DNA mixture interpretation, *Sci. Justice* 51 (2011) 204–208.
- [26] T. Laber, P.E. Kish, M.C. Taylor, G. Owens, N. Osborne, J. Curran, Reliability Assessment of Current Methods in Bloodstain Pattern Analysis, National Institute of Justice, 2014, pp. 1–77 Document No.: 247180.
- [27] S. Nakhaeizadeh, I. Hanson, N. Dozzi, The power of contextual effects in forensic anthropology, a study of bias ability in the visual interpretations of trauma analysis on skeletal remains, *J. Forensic Sci.* 59 (2014) 1177–1183.
- [28] C.A.J. van den Eeden, C.J. de Poot, P.J. van Koppen, The forensic confirmation bias: a comparison between experts and novices, *J. Forensic Sci.* (2018) 1–7.
- [29] W.C. Thompson, What role should investigative facts play in the evaluation of scientific evidence? *Aust. J. Forensic Sci.* 43 (2011) 123–134.
- [30] I.E. Dror, Practical solutions to cognitive and human factor challenges in forensic science, *Forensic Sci. Policy Manag.* 4 (2013) 105–113.
- [31] B. Found, J. Ganas, The management of domain irrelevant context information in forensic handwriting examination casework, *Sci. Justice* 53 (2013) 154–158.
- [32] R. Zajac, N. Osborne, L. Singley, M. Taylor, Contextual Bias: what bloodstain pattern analysts need to know, *J. Bloodstain Pattern Anal.* 31 (2015) 7–16.
- [33] I.E. Dror, W.C. Thompson, C.A. Meissner, I. Kornfield, D. Krane, M. Saks, M. Risinger, Context management toolbox: a linear sequential unmasking (LSU) approach for minimizing cognitive bias in forensic decision making, *J. Forensic Sci.* 60 (2015) 1111–1112.
- [34] D.E. Krane, S. Ford, J.R. Gilder, K. Inman, A. Jamieson, R. Koppl, I.L. Kornfield, D.M. Risinger, N. Rudin, M.S. Taylor, W.C. Thompson, Sequential unmasking: a means of minimizing observer effects in forensic DNA interpretation, *J. Forensic Sci.* 53 (2008) 1006–1007.
- [35] A.M. Jeanguenat, B. Budowle, I.E. Dror, Strengthening forensic DNA decision making through a better understanding of the influence of cognitive bias, *Sci. Justice* 57 (2017) 415–420.
- [36] S. Moser, Confirmation Bias: the pitfall of forensic science, *Themis* 1 (2013) (Article 7).
- [37] S.D. Charman, The forensic confirmation bias: a problem of evidence integration, not just evidence evaluation, *J. Appl. Res. Mem. Cogn.* 2 (2013) 56–58.
- [38] Regulator FS, Guidance: Cognitive Bias Effects Relevant to Forensic Science Examinations, Home Office, London, UK, 2015.
- [39] National Commission on Forensic Science, Ensuring that Forensic Analysis Is Based upon Task-Relevant Information, National Institute of Standards and Technology, U.S. Department of Commerce, 2015.
- [40] G. Edmond, K. Martire, R. Kemp, D. Hamer, B. Hibbert, A. Ligertwood, G. Porter, M. San Roque, R. Searston, J. Tangen, M. Thompson, D. White, How to cross-examine forensic scientists: a guide for lawyers, *Aust. Bar Rev.* 39 (2014) 174–197.
- [41] G. Edmond, A. Towler, B. Grown, G. Ribeiro, B. Found, D. White, K. Ballantyne, R.A. Searston, M.B. Thompson, J.M. Tangen, R.I. Kemp, K. Martire, Thinking forensics: cognitive science for forensic practitioners, *Sci. Justice* 57 (2017) 144–154.
- [42] President's Council of Advisors on Science and Technology, Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods, (2016).
- [43] N.K.P. Osborne, M.C. Taylor, Contextual information management: an example of independent-checking in the review of laboratory-based bloodstain pattern analysis, *Sci. Justice* 58 (2018) 226–231.
- [44] G. Langenburg, Addressing potential observer effects in forensic science: a perspective from a forensic scientist who uses linear sequential unmasking techniques, *Aust. J. Forensic Sci.* 49 (2017) 548–563.
- [45] L.E. Wilson, M.E. Gahan, C. Lennard, J. Robertson, Developing a strategic forensic science risk management system as a component of the forensic science system of systems, *Aust. J. Forensic Sci.* (2018), <https://doi.org/10.1080/00450618.2018.1510032>.
- [46] Royal Commission of inquiry in respect to the case of Edward Charles Splatt (SA), Royal Commission Report Concerning the Conviction of Edward Charles Splatt, Government Printer, 1984.
- [47] Audit and Risk Committee, Risk Management Procedure, Attorney-General's Department, South Australian Government, 2017.
- [48] SAI Global Ltd, AS/NZ ISO 31000: 2009, Risk Management – Principles and Guidelines, ISO, Switzerland, 2009.
- [49] D.N. Sims, N.E. Langlois, R.W. Byard, An approach to peer review in forensic pathology, *J. Forensic Legal Med.* 20 (2013) 402–403.
- [50] I.E. Dror, R.M. Morgan, C. Rando, S. Nakhaeizadeh, The bias snowball and the bias cascade effects: two distinct biases that may impact forensic decision making, *J. Forensic Sci.* 63 (2017) 832–833.
- [51] F.H.R. Vincent, Inquiry into the Circumstances that Led to the Conviction of Mr Farah Abdulkadir Jama, Victorian Government Printer, 2010.